Q1.a) $L_{eq}=L$

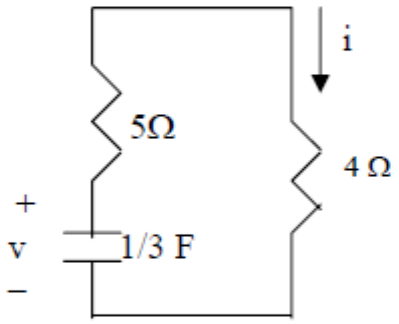
Q1.b) $C_{eq}= 4F$

Q2)

Let v be the voltage across the capacitor.
For t <0,

$$v(0^-) = \frac{4}{2+4}(24) = 16 \text{ V}$$

For t >0, we have a source-free RC circuit as shown below.



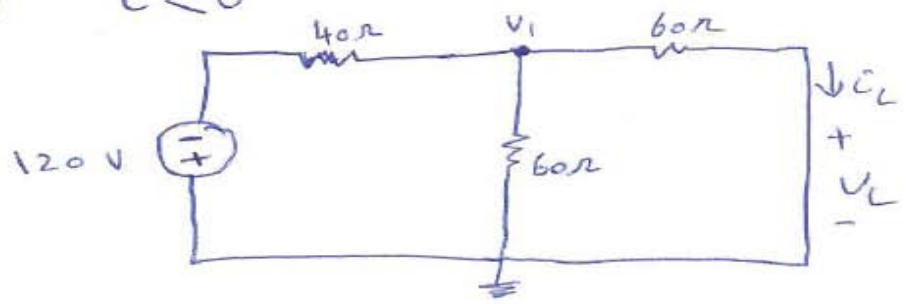
$$\tau = RC = (4+5)\frac{1}{3} = 3s$$

$$v(t) = v(0)e^{-t/\tau} = 16e^{-t/3}$$

$$i(t) = -C\frac{dv}{dt} = -\frac{1}{3}(-\frac{1}{3})16e^{-t/3} = \underline{1.778e^{-t/3}\ \text{A}}$$

Q3)

) $t<0$



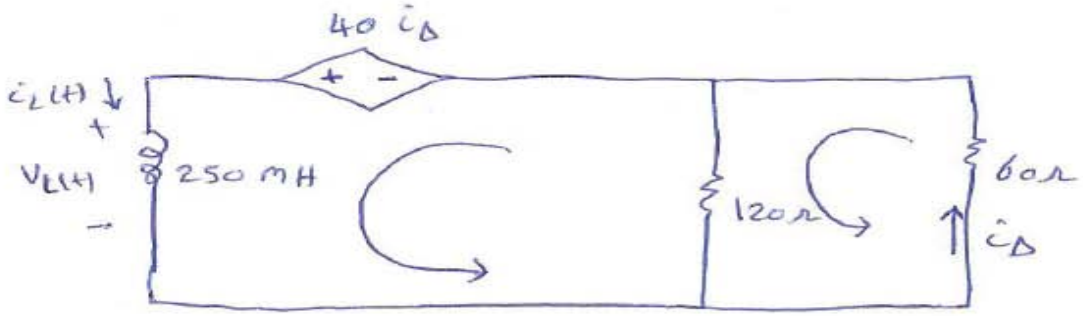
$$\frac{V_1+120}{40}+\frac{V_1}{60}+\frac{V_1}{60}=0 \Rightarrow V_1=-51.42\ V$$

$$i_L=\frac{V_1}{60}=-0.86\ A$$

$$V_L=0$$

$$i_\Delta=0$$

$t\geq 0$



$$L\frac{di_{L(t)}}{dt}+120(i_L-i_\Delta)-40\,i_\Delta=0$$

$$0.25\frac{di_L}{dt}+120\,i_L-160\,i_\Delta=0$$

$$60\,i_\Delta+120(i_\Delta-i_L)=0 \Rightarrow i_\Delta=0.67\,i_L$$

$$\Rightarrow .25\frac{di_L}{dt}+120\,i_L-107.2\,i_L=0$$

$$\frac{di_L}{dt}+51.2\,i_L=0$$

$$i_{L(t)}=i_L(0)\,e^{-51.2t}=-.86\,e^{-51.2t}$$

Contin)

$$v_L(t) = L\frac{di_L(t)}{dt} = (.25)(-.86\,e^{-51.2t}) = -0.215\,e^{-51.2t}$$

$$i_D(t) = 0.67\,i_L(t) = (0.67)(-.86\,e^{-51.2t}) = -0.57\,e^{-51.2t}$$

$$\Rightarrow \quad i_L(t) = \begin{cases} -0.86 & ; t<0 \\ -0.86\,e^{-51.2t} & ; t\geq 0 \end{cases}$$

$$v_L(t) = \begin{cases} 0 & ; t<0 \\ -0.215\,e^{-51.2t} & ; t\geq 0 \end{cases}$$

$$i_D(t) = \begin{cases} 0 & ; t<0 \\ -0.57\,e^{-51.2t} & ; t\geq 0 \end{cases}$$

Q4)

Applying KCL @ node A

$$\frac{V_\phi}{15k\Omega} + V_\phi + \frac{V_\phi - V_c}{20k\Omega} = 0$$

$$V_\phi \left[1/15000 + 1 + \frac{1}{20000}\right] = \frac{V_c}{20000}$$

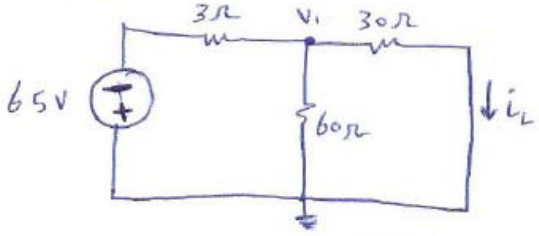
$$V_\phi = \frac{V_c}{20000\left[\frac{1}{15000} + 1 + \frac{1}{20000}\right]} = \frac{V_c}{\left[4/3 + 20000 + 1\right]}$$

$$= \frac{V_c}{20002.33}$$

$$= 1.799\, e^{-t/15}\ mV$$

Q5)

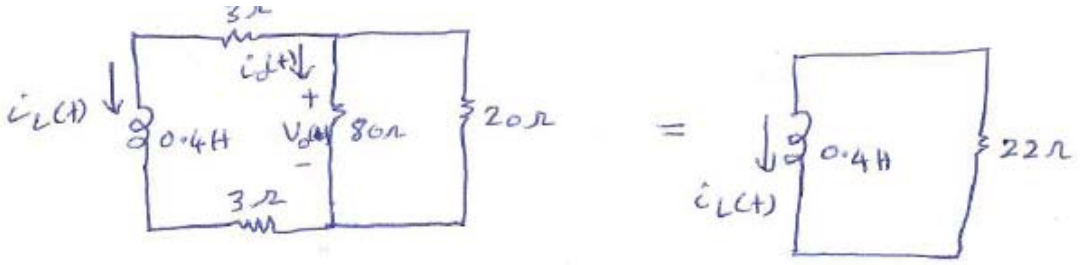
$t<0$



$$\frac{V_1+65}{3}+\frac{V_1}{60}+\frac{V_1}{30}=0 \Rightarrow V_1=-56.52\ V,\ i_L=\frac{V_1}{30}=-1.88\ A$$

$V_0=0$

$t\geq 0$



$$i_L(0)=i_L(0^-)=-1.88A$$

$$i_L(t)=i_L(0)\,e^{-55t}=-1.88\,e^{-55t}$$

$$i_0(t)=\frac{20}{20+80}\left(-i_L(t)\right)$$

$$=0.37\,e^{-55t}$$

$$V_0(t)=(80)(.37\,e^{-55t})=30\,e^{-55t}$$

$$\Rightarrow\quad V_0(t)=\begin{cases}0 & ;\ t<0\\ 30\,e^{-55t} & ;\ t\geq 0\end{cases}$$